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IS 13656 (2002): Internal Combustion Engine Crankcase Oils (Diesel and Gasoline) [PCD 3: Petroleum, Lubricants and their Related Products]

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(पहला पुनरीक्षण)

Indian Standard

INTERNAL COMBUSTION ENGINE CRANKCASE OILS (DIESEL AND GASOLINE) — SPECIFICATION

(First Revision)

ICS 43.060.01;75.100

14/03/02

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 8

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Lubricants and Related Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

IS 496 'Specification for automotive internal combustion engine lubricating oils' was first published in 1955. It was subsequently revised in 1966, 1973, 1979 and 1982 reflecting the changing requirements of OEM's and users. The 1982 version was base stock specific. However, the other two standards on the subject, based on re-refined oils and base stock of mixed crude were as under:

a) IS 9048 : 1982 Specification for re-refined automotive internal combustion engine lubricating oils (*first revision*), and

b) IS 10356 : 1982 Specification for automotive internal combustion engine lubricating oils from base stocks of mixed crude.

Eventually the Committee decided to issue an amalgamated version as IS 13656 : 1993 'Internal combustion engine crankcase oils (gasoline and diesel)' covering the requirements of upgraded quality of crankcase oil irrespective of varying base stock.

In the post-1992 economic liberalization era, significant developments have been taking place in the Indian Automotive Industry as well as the lubricant manufacturing and marketing industry — particularly in terms of technology upgradation and product diversification. The current state of engine technology has approached global standards both by way of new OEM's in the field deploying latest technologies and the others modifying engine designs to meet the current and anticipated national auto emission standards. The oil industry also has been responding with offer of lubricants of matching performance. In keeping with these developments, the committee decided to revise and update this Standard. This version (first revision) reflects some of the latest performance standards being employed by the API, ACEA and OEM's to define oils that are required for equipment currently in use in the country. Two types of diesel lubricating oil, namely, E-DL5 and E-DL6 have been included with their equivalent international performance levels indicated. EPL category of passenger car motor oils have been drafted and a new type E-PL4 with overseas performance as API SJ level has been included. In this version, the corresponding equivalent overseas performance levels have been well defined. The Table on characteristics and requirements for base oil without additives has been dispensed with.

Considering various factors such as frequent upgradation of global specifications, obsolescence of hardware, increasing costs of engine testing and the dearth of test facilities, it is anticipated that oil marketers would increasingly utilize existing engine-test database to claim performance against various categories. Where the product performance category essentially involves a cross labelling between an API category, an ACEA category and/or an OEM specification, the particular code of practice and/or read across guidelines stipulated by the particular agency need be utilized in order to support the particular claim.

A significant feature of this specification is the coverage of the following two principal application-areas of lubricants:

a) Diesel Engine Lubricating Oils, and

b) Passenger Car Motor Oils.

This specification does not cover the entire range of performance levels of lubricants currently in use in the country. Based on extensive interaction with OEM's in the country, it was decided to cover only those categories that are currently recommended by automotive OEM's for their engines.

(Continued on third cover)

Indian Standard

INTERNAL COMBUSTION ENGINE CRANKCASE OILS (DIESEL AND GASOLINE) — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test for the various types (*see* **3**) of internal combustion engine lubricating oils for use in diesel engines and gasoline engines used in passenger and commercial vehicles including off-highway equipment.

1.2 This standard may also apply to lubricants used in internal combustion engines for stationary applications such as generators, compressors and pumps, wherever so recommended by the manufacturers or adopted by the users.

1.3 This standard permits the use of multi-labelled oils for lubrication of compression-ignition types of internal-combustion engines used in passenger and commercial vehicles, off-highway vehicles and industrial equipment.

1.4 Lubricating oils, covered in this standard, are broadly classified into two types as specified in **3**, under the nomenclature as Diesel Engine Oils (DEO), Passenger Car Motor Oils (PCMO).

2 REFERENCES

The following Indian Standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1447 (Part 1) : 2000	Petroleum and its products — Methods of sampling : Part 1 Manual sampling (*first revision*)
1448	Methods of test for petroleum and its products:
[P : 1] : 1971	Neutralization number of potentiometric titration (*first revision*)
[P : 4] : 1984	Ash, sulphated ash and water soluble ash (*second revision*)
[P : 10] : 1970	Cloud point and pour point (*first revision*)
[P : 15] : 1976	Detection of copper corrosion from petroleum products by the copper strip tarnish test (*second revision*)
[P : 16] : 1990	Density of crude petroleum and liquid petroleum products by hydrometer method (*third revision*)
[P : 21] : 1992	Flash point (closed) by Pensky Martens Apparatus (*second revision*)
[P : 25] : 1976	Determination of kinematic and dynamic viscosity (*first revision*)
[P : 33] : 1991	Sulphur by bomb method (*second revision*)
[P : 54] : 1979	Determination of phosphorous in lubricating oil; Quinoline phosphomolybdate method (*first revision*)
[P : 56] : 1980	Viscosity index by calculation (*second revision*)
[P : 67] : 1982	Foaming characteristics of lubricating oils (*first revision*)
[P : 69] : 1969	Flash and fire point by cleveland (open) cup
[P : 77] : 1971	Metallic constituents of lubricating oils, chemical method
[P : 86] : 1977	Determination of total base number by potentiometric perchloric acid titration method
[P : 40] : 1987	Water by distillation (*third revision*)
[P : 108] : 1982	Apparent viscosity of engine oil at low temperature using the cold-cranking simulator
[P : 122] : 1987	Conradson carbon residue of petroleum products

3 CLASSIFICATION

3.1 Types and Performance Level Categories

Internal Combustion Engine lubricating Oils covered in this standard are of two types, that is, Diesel Engine Lubricating Oils and Passenger Car Motor Oils. They shall be qualified under the different performance-level categories, as per designations indicated in **3.1.1** and **3.1.2**. Corresponding international equivalent performance levels and the prescribed engine tests are indicated, for the purpose of ready reference, against each of the designated categories.

Some of the prescribed test methods may no longer be available, and in such event the Engine Oil Qualification Approval Panel may consider alternate data provided as proof of performance level.

3.1.1 *Diesel Engine Lubricating Oils (DEO)*

Sl No.	*IS Category*	*International Equivalent*	*Engine Tests* [For test methods, *see* **3.4** and **5.2**, and Table 2]
1.	EDL 1	API CC	CLR L-38, Cat 1H2 or MWM-B
2.	EDL 2	API CD / CF	CLR L-38, Cat 1G2 or MWM-B / CLR L-38, Cat.1M-PC
3.	EDL 3	API CD / CF Plus MACK T-7/ T-8A	CLR L-38, Cat 1G2 or MWM-B / CLR L-38, Cat.1M-PC Plus Mack T-7 or Mack T-8A
4.	EDL 4	API CF- 4	CLR L-38, MackT-6, MackT-7or Mack T-8A, Cat 1K
5.	EDL 5	API CF-4 combined with ACEA E2-96; DB 228.1[1]	CLR L-38, MackT-6, MackT-7 or Mack T-8A, Cat.1K OM 364A, OM602A, Mack T-8
6.	EDL 6	ACEA E3-96; DB 228.3[1]	OM 364A, OM602A, Mack T-8

3.1.2 *Passenger Car Motor Oils (PCMO)*

Sl No.	*IS Category*	*International Equivalent*	*Engine Tests* [For test methods, *see* **3.4** and **5.2**, and Table 2]
1.	EPL 1	API SC	a) CLR L-38 b) CLR LTD c) Cat 1H2 or MWM-B
2.	EPL 2	API SF	a) CLR L-38 b) Sequence IID c) Sequence IIID d) Sequence VD
3.	EPL 3	API SG	a) CLR L-38 b) Sequence IID c) Sequence IIIE d) Sequence VE e) Sequence VIA (optional) only for FE oils
4.	EPL 4	API SJ	a) CLR L-38 b) Sequence IID c) Sequence IIIE d) Sequence VE e) Sequence VIA (optional) only for FE oils Mandatory catalytic converter compatibility

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[1] Of the common engine tests in performance levels indicated, the more severe test criteria will apply.

These oils may or may not contain friction modifiers. In certain cases, use of friction modifier containing oils in 4-stroke engines for 2 or 3 wheeler vehicles is not desirable. Users of 2 or 3 wheelers powered by 4-stroke engines are advised to refer to the oil recommendations by the original equipment manufacturers.

3.2 The oils can be labelled as fuel-efficient by suffixing the grade name with word 'FE', provided the oil meets fuel-economy targets as per the sequence VI A specified in Table 3. These oils may or may not contain friction modifier.

3.3 Viscosity Grades

3.3.1 The oils shall conform to one of the SAE mono-viscosity grades (*see* Table 1) or SAE multi-grades, which are combinations of W-Grades and other mono-grades, as for example: SAE 10 W and SAE 30 for the SAE 10W-30 grade. Viscosity limits for each of the mono-grades are also given in Table 1.

3.3.2 In case of multi-grades, the prescribed viscosity limits (*see* Table 1) for both the constituent components of the multi-grade, shall be met.

3.4 Engine-Performance Test Requirements

The approved engine tests for performance evaluation of the two types of lubricants and their various performance categories, have been listed in the tables as given below, together with the prescribed passing limits:

a) Diesel Engine Oils — Table 2

b) Passenger Car Motor Oils — Table 3

The dispensations allowed in applying the engine test evaluation criteria, and the role of the Engine Oil Qualification Approval Panel in interpreting whether the lubricant meets the performance requirements of the standard, are elaborated in **5**.

4 REQUIREMENTS

4.1 General

The oils shall be formulated by blending lube base stocks comprising of virgin oil or re-refined oil or synthetic fluid, or a combination of any of these, and additive components as necessary, to meet the requirements of this standard.

4.2 Physico-Chemical Requirements

4.2.1 The oil shall be free from suspended matter, grit, water or any other foreign matter and impurities.

4.2.2 The oil shall comply with the physico-chemical and other bench-test requirements as specified below.

4.2.2.1 *For diesel engine oils*

a) Viscosity requirements as per Table 1, and

b) Physico-chemical requirements (other than viscosity) as per Table 1A.

4.2.2.2 *For passenger car motor oils*

a) Viscosity requirements as per Table 1,

b) Physico-chemical requirements (other than viscosity) as per Table 1A, and

c) Compositional and bench test requirements as per Table 4.

4.3 Stability and Compatibility of Finished Lubricating Oils

4.3.1 The finished blended oils shall have the additive elements uniformly distributed throughout the oil and shall show no evidence of instability at temperature specified in the homogeneity and miscibility test described in Annex A.

4.3.2 The oil shall be compatible with all other oils qualified as demonstrated by the homogeneity and miscibility test described in Annex A using standard reference oils approved by the qualifying authority.

5 QUALIFICATION APPROVAL

5.1 The procedure to assess qualifying oils, as meeting the requirements of this standard, is based on the review of the data presented and recommendation of a Panel of members designated as 'Engine Oil Qualification Approval Panel' (EOQAP) or the 'Panel'.

5.2 Documentation in specified format shall be submitted by the applicant-organization to the Bureau of India Standards (BIS), which shall be forwarded under code to the convener of the panel without disclosing the name or identity of the applicant-organization. The procedure for securing qualification of lubricating engine oils against this standard requires submission of the following information and documentation by the applicant-organization to the Bureau:

a) Type, viscosity grade and performance-category of the standard against which approval is sought, including cross-labelling requirements, if any;

b) Product identification code/brand name of the oil with viscometric grade(s);

c) Conformance to composition, physico-chemical, other rheological and bench test requirements as per Tables 1, 1A and 4;

d) Product identification data as per Table 5;

e) Engine-performance data as stipulated in **3.4**; and

f) Any supplementary or alternate data, or evidence in support of the performance claims.

It is possible that the performance test data would be generated on engine tests carried out in different laboratories conducted at different periods of time, using base stocks from different sources. It is also possible that certain test facilities referred in the standard may not be available. However, the applicant shall satisfy the Engine Oil Qualification Approval Panel about validity of the provisions exercised by him in terms of base oil interchange, viscosity read-across, minor additive component substitution, etc. (as provided in the relevant API/ACEA/OEM specifications) and that the data presented is valid for the applicant's formulation in vogue. The Panel, based on an overall review of the performance data, shall decide whether the lubricating oil formulated by the applicant meets the requirements of this standard. The panel shall accordingly, communicate its decision to the Bureau.

6 PRODUCT IDENTIFICATION

To ensure acceptance of only qualified products and for the purposes of product identification, tests may be carried out by the purchaser or his agency on the characteristics of the oil mentioned in Table 5 and the test results shall be compared with the corresponding figures given in the product identification report. Permissible tolerances of the results are indicated against each of the characteristics in Table 5.

7 PACKING AND MARKING

7.1 Packing

The material shall be packed in metal containers or in any other suitable containers as agreed to between the purchaser and the supplier.

7.2 Marking

7.2.1 The container shall be securely closed and marked with the following:

a) Indication of the source of manufacture, recognized trade-mark, if any;

b) Type and grade;

c) Net mass/volume of the material; and

d) Identification in code or otherwise to enable the lot of consignment of manufacture to be traced back from records.

7.2.2 All markings including batch number or lot of manufacture shall be made on one flat end when the material is packed in barrels.

7.2.3 *BIS Certification Marking*

Each container may also be marked with the Standard Mark.

7.2.3.1 The use of Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufactures or producers may be obtained from the Bureau of Indian Standards.

8 SAMPLING

8.1 Representative samples of the material shall be drawn as prescribed in IS 1447 (Part 1).

8.2 Number of Tests

Test for all the characteristics given in Tables 1 and 5 of this standard shall be conducted on the composite sample.

8.3 Criteria for Conformity

The lot shall be declared as conforming to the requirements of the specification if all the results on the composite sample satisfy the relevant requirements.

Table 1 Engine Oil Viscosity Classification1)

[*Clauses* 3.3.1, 3.3.2, 4.2.2.1 (a), 4.2.2.2 (a) *and* 5.2]

SAE Viscosity Grade	**Low Temp Cranking Viscosity, cP** *Max*	**Low Temp Pumping Viscosity, cP** *Max*	**Low-Shear-Rate Kinematic Viscosity, cSt at 100°C** *Min*	**Low-Shear-Rate Kinematic Viscosity, cSt at 100°C** *Max*	**High-Shear-Rate Viscosity (cP) at 150°C and $10^6 s^{-1}$** *Min*
	Method of Test				
	ASTM D5293	ASTM D3829	IS 1448 [P:25]	IS 1448 [P:25]	ASTM D4683
0 W	6 200 at –35°C	60 000 at –40°C	3.8	—	—
5 W	6 600 at –30°C	60 000 at –35°C	3.8	—	—
10 W	7 000 at –25°C	60 000 at –30°C	4.1	—	—
15 W	7 000 at –20°C	60 000 at –25°C	5.6	—	—
20 W	9 500 at –15°C	60 000 at –20°C	5.6	—	—
25 W	13 000 at –10°C	60 000 at –15°C	9.3	—	—
20	—	—	5.6	<9.3	2.6
30	—	—	9.3	<12.5	2.9
40	—	—	12.5	<16.3	2.9 (0W-40, 5W-40 and 10W-40 grades)
40	—	—	12.5	<16.3	3.7 (15W-40, 20W-40, 25W-40,and 40 grades)
50	—	—	16.3	<21.9	3.7
60	—	—	21.9	<26.1	3.7

1)SAE J 300 December 1999.

Table 1A Requirement for Physico-Chemical (Other than Viscosity)

(*Clauses* 4.2.2.1, 4.2.2.2 *and* 5.2)

Sl No.	Characteristics	Requirement for Grade												
(1)	(2)	SAE 0W (3)	SAE 5W (4)	SAE 10W (5)	SAE 15W (6)	SAE 20W (7)	SAE 25W (8)	SAE 20 (9)	SAE 30 (10)	SAE 40 (11)	SAE 50 (12)	SAE 60 (13)	Multi-grade (14)	Method of Test, Ref to IS 1448 (15)
i)	Appearance	When examined in transmitted light in a colourless glass test-tube of 25 mm internal diameter, oil shall be clear, bright and free from turbidity and sediment.												—
ii)	Viscosity index, *Min*	100	100	100	95	95	95	95	95	90	90	90	—	P : 56
iii)	Pour point, °C, *Max*	-33	-33	-27	-24	-21	-15	-9	-6	-6	-6	6	—	P : 10
iv)	Flash point COC °C, *Min*	160	160	190	190	200	200	200	215	215	220	220	200 or 185	P : 69
v)	Evaporative loss, percent, *Max*	20	20	20	15	15	15	15	10	10	10	10	22 or 20 ©	P : 136
vi)	Foaming tendency/stability quantity of foam ml/ml, *Max* a) at 24°C, *Max* b) at 93.5°C, *Max* c) at 24°C after the test at 93.5°C	←25/Nil→ ←150/Nil→ ←25/Nil→												—

NOTES

1 For defence requirement pour point for SAE 30 and SAE 40 shall be –18°C, *Max* and for SAE 50 shall be –9°C, *Max*.

2 Flash point for multigrade is valid only for 0W-20, 5W-20, 5W-30, 10W-30 and for other multigrades it is not required.

3 Evaporation loss for SAE 0W-20, 5W-20, 5W-30, 10W-30 is 22 and for SAE 15W-40 it is 20.

4 For SJ category the foaming tendency requirement shall be 10/0, 50/0, 10/0 (P-67) and 200/50 for high temperature foaming tendency ASTM D 6082. High temperature foaming tendency/stability quantity of foam ml/ml, *Max*.

Table 2 Engine Test Sequence for Diesel Engine Oils

(*Clauses* 3.1.1, 3.1.2 *and* 3.4)

<table>
<tr><th rowspan="2">Test Technique
(1)</th><th rowspan="2">Performance Criteria
(2)</th><th colspan="10">Passing Limits</th><th rowspan="2">Test Method
(9)</th></tr>
<tr><th>EDL 1
(3)</th><th>EDL 2
(4)</th><th>EDL 3
(5)</th><th colspan="3">EDL 4
(6)</th><th colspan="3">EDL 5
(7)</th><th>EDL 6
(8)</th></tr>
<tr><td rowspan="2">L-38</td><td>a) Bearing weight loss mg, <i>Max</i></td><td>50</td><td>50</td><td>50</td><td colspan="3">50</td><td colspan="3">50</td><td>—</td><td rowspan="2">ASTM D5119-95</td></tr>
<tr><td>b) Piston skirt varnish, <i>Min</i></td><td>9</td><td>9[1]</td><td>9[1]</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td rowspan="4">Cat 1H2</td><td>a) Top groove ring filling percent, vol, <i>Max</i></td><td>45</td><td>45</td><td>45</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td><td rowspan="4">ASTM STP-509A Part II</td></tr>
<tr><td>b) Weighted total demerit, <i>Max</i></td><td>140</td><td>140</td><td>140</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>c) Evidence of ring sticking or wear</td><td>None</td><td>None</td><td>None</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>d) Ring side clearance increase, mm, <i>Max</i></td><td>0.013</td><td>0.013</td><td>0.013</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td rowspan="4">Cat 1G2</td><td>a) Top groove ring filling, percent, vol, <i>Max</i></td><td>—</td><td>80</td><td>80</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td><td rowspan="4">ASTM STP-509A Part I</td></tr>
<tr><td>b) Weighted total demerit, <i>Max</i></td><td>—</td><td>300</td><td>300</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>c) Evidence of ring sticking or wear</td><td>—</td><td>None</td><td>None</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>d) Ring side clearance increase, mm, <i>Max</i></td><td>—</td><td>0.013</td><td>0.013</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>MWM-B</td><td>a) Overall merit rating, <i>Min</i></td><td>55</td><td>65</td><td>65</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td><td>CEC-L-12-A-76</td></tr>
<tr><td rowspan="5">Cat. 1M- PC</td><td>a) Top groove ring filling, percent, vol, <i>Max</i></td><td>—</td><td>7</td><td>7</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td><td rowspan="5">ASTM RR:DO2:1320</td></tr>
<tr><td>b) Weighted total demerit (WTD), <i>Max</i></td><td>—</td><td>240</td><td>240</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>c) Ring side clearance loss, mm, <i>Max</i></td><td>—</td><td>0.013</td><td>0.013</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>d) Piston ring sticking</td><td>—</td><td>None</td><td>None</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td>e) Piston, ring and liner scuffing</td><td>—</td><td>None</td><td>None</td><td colspan="3">—</td><td colspan="3">—</td><td>—</td></tr>
<tr><td rowspan="7">Cat. 1K
(EDL 4 and EDL5)</td><td>Run number</td><td>—</td><td>—</td><td>—</td><td colspan="2">2</td><td colspan="2">3</td><td colspan="2">4</td><td>—</td><td rowspan="7">ASTM RR:DO2:1273</td></tr>
<tr><td>a) Weighted demerits (WDK), <i>Max</i></td><td>—</td><td>—</td><td>—</td><td colspan="2">332</td><td colspan="2">339</td><td colspan="2">342</td><td>—</td></tr>
<tr><td>b) Groove 1 carbon fill, percent, vol, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td colspan="2">24</td><td colspan="2">26</td><td colspan="2">27</td><td>—</td></tr>
<tr><td>c) Top land heavy carbon, percent, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td colspan="2">4</td><td colspan="2">4</td><td colspan="2">5</td><td>—</td></tr>
<tr><td>d) Oil consumption, g/kW-h</td><td>—</td><td>—</td><td>—</td><td colspan="2">0.27</td><td colspan="2">0.27</td><td colspan="2">0.27</td><td>—</td></tr>
<tr><td>e) Scuffing piston ring liner</td><td>—</td><td>—</td><td>—</td><td colspan="2">None</td><td colspan="2">None</td><td colspan="2">None</td><td>—</td></tr>
<tr><td>f) Piston ring sticking</td><td>—</td><td>—</td><td>—</td><td colspan="2">None</td><td colspan="2">None</td><td colspan="2">None</td><td>—</td></tr>
<tr><td>Mack T-6</td><td>Merit rating, <i>Min</i></td><td>—</td><td>—</td><td>—</td><td colspan="3">90</td><td colspan="3">90</td><td>—</td><td>ASTM RR:DO2:1219</td></tr>
</table>

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[1] Shall not be applicable for CF and CF plus Mack T-7.

Table 2 (*Concluded*)

<table>
<tr><th>Test Technique
(1)</th><th>Performance Criteria
(2)</th><th colspan="6">Passing Limits</th><th>Test Method
(9)</th></tr>
<tr><th></th><th></th><th>EDL 1
(3)</th><th>EDL 2
(4)</th><th>EDL 3
(5)</th><th>EDL 4
(6)</th><th>EDL 5
(7)</th><th>EDL 6
(8)</th><th></th></tr>
<tr><td>Mack T-7</td><td>a) Average rate of kinematic viscosity increase during last 50 h, mm²/s at 100°C/h, <i>Max</i></td><td>—</td><td>—</td><td>0.040</td><td>0.040</td><td>0.040</td><td>—</td><td>ASTM RR:DO2:1220</td></tr>
<tr><td></td><td>b) Copper, mg/kg (ppm) increase, <i>Max</i></td><td>—</td><td>—</td><td>20</td><td>20</td><td>20</td><td>—</td><td></td></tr>
<tr><td>Mack T-8</td><td>Run number</td><td>—</td><td>—</td><td>—</td><td>—</td><td colspan="2">1   2   3</td><td>ASTM D5967</td></tr>
<tr><td></td><td>a) Viscosity increase at 3.8 percent soot cSt, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td colspan="2">11.5   12.5   13.0</td><td></td></tr>
<tr><td></td><td>b) Filter plugging, differential-pr. psi, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td colspan="2">20   20   20</td><td></td></tr>
<tr><td></td><td>c) Oil consumption, g/kW-h, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td colspan="2">0.30   0.30   0.30</td><td></td></tr>
<tr><td></td><td>(EDL 5, Oil consumption — Rate and report)</td><td>—</td><td>—</td><td>—</td><td>—</td><td colspan="2"></td><td></td></tr>
<tr><td>OM 364A</td><td>a) Bore polishing, percent, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>8.0</td><td>2.5</td><td>CEC-L-42-A-92</td></tr>
<tr><td></td><td>b) Piston cleanliness, merit, <i>Min</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>31</td><td>35</td><td></td></tr>
<tr><td></td><td>c) Average cylinder wear, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>0.007</td><td>0.006</td><td></td></tr>
<tr><td></td><td>d) Engine sludge average merit, <i>Min</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>9.0</td><td>9.5</td><td></td></tr>
<tr><td></td><td>e) Oil consumption, kg/test, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>18.0</td><td>12.0</td><td></td></tr>
<tr><td>OM 602A</td><td>a) Bore polishing, percent, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>6.0</td><td>4.5</td><td>CEC-L-51-T-95</td></tr>
<tr><td></td><td>b) Piston cleanliness, merit, <i>Min</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>22.0</td><td>24.0</td><td></td></tr>
<tr><td></td><td>c) Average cylinder wear, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>18.0</td><td>15.0</td><td></td></tr>
<tr><td></td><td>d) Engine sludge average merit, <i>Min</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>8.9</td><td>8.9</td><td></td></tr>
<tr><td></td><td>e) Oil consumption, kg/test, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>10.0</td><td>10.0</td><td></td></tr>
<tr><td></td><td>f) Cam wear average, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>50.0</td><td>45.0</td><td></td></tr>
<tr><td></td><td>g) Viscosity increase at 40°C, percent, <i>Max</i></td><td>—</td><td>—</td><td>—</td><td>—</td><td>80.0</td><td>70.0</td><td></td></tr>
</table>

NOTE — MTAC shall follow wherever applicable.

Ref : ASTM D4485-98

Table 3 Engine Test Sequence for Passenger Car Motor Oils

(*Clauses* 3.2 *and* 3.4)

Test Technique (1)	**Performance Criteria** (2)	**Passing Limits**				**Test Method** (7)
		EPL 1 (3)	EPL 2 (4)	EPL 3 (5)	EPL 4 (6)	
CLR L-38	a) Bearing weight loss mg, *Max*	50	40	40	40	ASTM D5119-95
	b) Piston skirt varnish, *Min*	—	—	9.0	—	
Sequence IID	a) Average engine rust rating, *Min*	—	8.5	8.5	8.5	ASTM D5844
	b) Number stuck lifters	—	None	None	None	
Sequence IIID	a) Viscosity increase at 40°C after 64 h test	—	375%	—	—	ASTM STP 315 H Part II
	b) Average engine sludge rating, *Min*	—	9.2	—	—	
	c) Average piston skirt varnish rating, *Min*	—	9.2	—	—	
	d) Average oil ring land deposits, *Min*	—	4.8	—	—	
	e) Ring sticking	—	None	—	—	
	f) Lifter sticking	—	None	—	—	
	g) Cam or lifter scuffing	—	None	—	—	
Sequence IIIE	a) Average piston varnish rating, *Min*	—	—	8.9	8.9	ASTM D5533
	b) Average oil ring land deposits, *Min*	—	—	3.5	3.5	
	c) Average engine sludge rating, *Min*	—	—	9.2	9.2	
	d) Hours to 375 percent kinematic viscosity increase at 40°C, *Min*	—	—	64	64	
	e) Cam plus lifter wear, mm					
	— Maximum	—	—	0.064	0.064	
	— Average	—	—	0.030	0.030	
	f) Lifter sticking	—	—	None	None	
	g) Cam or lifter scuffing	—	—	None	None	
	h) Ring sticking (oil related)	—	—	None	None	
Sequence VD	a) Average engine rating at 192 h	—	—	—	—	ASTM STP 315H Part (III)
	— Average engine sludge rating, *Min*	—	9.4	—	—	
	— Average engine varnish rating, *Min*	—	6.6	—	—	
	— Average piston skirt varnish rating, *Min*	—	6.7	—	—	
	b) Oil screen clogging, percent, *Max*	—	7.5	—	—	
	c) Oil ring clogging, percent, *Max*	—	10.0	—	—	
	d) Compression ring sticking	—	None	—	—	
	e) Cam wear, mm					
	— Average	—	0.025	—	—	
	— Maximum	—	0.064	—	—	

Table 3 *(Concluded)*

Test Technique (1)	Performance Criteria (2)	Passing Limits				Test Method (7)
		EPL 1 (3)	EPL 2 (4)	EPL 3 (5)	EPL 4 (6)	
Sequence VE	a) Average engine sludge rating, *Min*	—	—	9.0	9.0	ASTM D5302
	b) Rocker arm cover sludge rating, *Min*	—	—	7.0	7.0	
	c) Average engine varnish rating, *Min*	—	—	5.0	5.0	
	d) Average piston skirt varnish, *Min*	—	—	6.5	6.5	
	e) Cam 1 wear, mm					
	— Maximum	—	—	0.380	0.380	
	— Average	—	—	0.127	0.127	
	f) Oil ring clogging, percent, *Max*	—	—	Report	Report	
	g) Oil screen clogging, percent, *Max*	—	—	20.0	20.0	
	h) Compression ring sticking (hot stuck)	—	—	None	None	
Sequence VIA (Optional) Only for FE oils	Fuel economy improvement *Vs.* ASTM BC-2 percent, *Min*	—	—	—	1.4 for 0W-20, 5W-20 1.1 for 0W-XX, 5W-XX 0.5 for 10W-XX	ASTM RR D2-1364
CAT 1H2	a) Top groove ring filling, percent, vol, *Max*	45	—	—	—	ASTM STP-509A Part II
	b) Weighted total demerit, *Max*	140	—	—	—	
	c) Evidence of ring sticking	None	—	—	—	
	d) Ring side clearance increase, mm, *Max*	0.013	—	—	—	
MWM-B	a) Overall merit rating, *Min*	55	—	—	—	CEC-L-12-A-76
CLR LTD	a) Piston skirt varnish merit, *Min*	7.5	—	—	—	FTMS 348
	b) Total engine varnish, merit, *Min*	42	—	—	—	
	c) Total engine sludge merit, *Min*	42	—	—	—	
	d) Oil ring plugging, percent, *Max*	10	—	—	—	
	e) Oil screen clogging, percent, *Max*	10	—	—	—	

Table 4 Compositional and Bench Test Requirements (Passenger Car Motor Oils)

(*Clauses* 4.2.2.2 *and* 5.2)

PCMO Performance Category	**Phosphorous Content** percent, mass, *Max*	**Filterability Flow Reduction**, percent, *Max*	**TEOST High Temperature Deposits**, mg, *Max*	**Gelation Index** *Max*
Test Method Reference (1)	IS 1448 [P:54] (2)	GM: 9099 P (3)	[1] (4)	ASTM D5133 (5)
EPL 2 (0W-20, 5W-20, 5W-30 10W-30)	0.12	—	—	—
EPL 3 (0W-20, 5W-20, 5W-30 10W-30)	0.12	—	—	—
EPL 4 (0W-20, 5W-20, 5W-30 10W-30)	0.10	50	60	12

[1] Refer ASTM D4485-1998.

Table 5 Requirements for Finished Product Identification and Permissible Variation for Product-Conformance

[*Clauses* 5.2 (d), 6 *and* 8.2]

Sl No.	Characteristics	Requirements	Method of Test, Ref to IS 1448
(1)	(2)	(3)	(4)
i)	Density at 15°C, g/ml	To be reported	[P:16]
ii)	Flash point COC, °C, *Min*	As specified in Table 1A	[P:69]
iii)	Pour point °C, *Max*	As specified in Table 1A	[P:10]
iv)	Kinematic viscosity, percent	±10 of the reported and within viscosity range of the grade	[P:25]
v)	Low temperature cranking viscosity, cP, *Max*	As specified in Table 1	[P:108]
vi)	Low temperature pumping, viscosity, cP, *Max*	As specified in Table 1	P:[1]/ASTM D4684
vii)	Viscosity-index, *Min*	As specified in Table 1A	[P:56]
viii)	Foam tendency/stability	as specified in Table 1A	[P:67]
ix)	Total base number	Up to 5: –0.5 to + open Above 5: –10 percent to + open	[P:86] [P:33]
x)	Total acid number	To be reported	[P:1]
xi)	Sulphur	±20 percent of the reported value	[P:33]/XRF
xii)	Sulphated ash	±20 percent of the reported value	[P:4]
xiii)	Calcium	–10 to +20 percent of the reported value	[P:77]/ASTM D4951
xiv)	Barium		do
xv)	Magnesium		do
xvi)	Zinc		do
xvii)	Phosphorus		[P:54]/ASTM D4951
xviii)	Nitrogen		P:[1]/ASTM D4629 upto 1 000 ppm ASTM D5291 above 1 000 ppm
xix)	Sodium		[P:77]/ASTM D4951

[1] Under preparation. Till such time it is published, ASTM D4684 for low temperature pumping and ASTM D4629 and D5291 for Nitrogen shall be followed.

ANNEX A

(*Clauses* 4.3.1 *and* 4.3.2)

HOMOGENEITY AND MISCIBILITY TEST

A-1 GENERAL

This test determines whether an oil is, will remain, homogeneous and whether it is miscible and be stable when blended with certain standard reference oils after being submitted to a prescribed cycle of temperature changes.

A-2 SAMPLE

A-2.1 Test Sample

Approximately 300 ml.

A-2.2 Standard Reference Oils

As approved by the qualifying authority.

A-3 APPARATUS

A-3.1 Test Jar — A test jar of clear glass, cylindrical form, flat bottom, approximately 30 to 35 mm in inside diameter and 115 to 125 mm in height.

A-3.2 Thermometers — Minus 50°C to plus 50°C range, conforming to ASTM E1-67 or its equivalent.

A-3.3 Cork — To fit the test jar, bored centrally to take the test thermometer.

A-3.4 Jacket — Glass or metal, water-tight, of cylindrical form, flat bottom, about 115 mm in depth, with inside diameter 9.5 to 12.5 mm greater than the outside diameter of the jar.

A-3.5 Disk — Cork or felt, 6 mm in thickness of the same diameter as the inside of the jacket.

A-3.6 Gasket — A ring gasket, about 5 mm in thickness, to fit snugly around the outside of test jar and loosely inside the jacket. The purpose of the rings gasket is to prevent the test jar from touching the jacket.

A-3.7 Bath — A cooling bath of a type suitable for obtaining the required temperatures.

A-4 PROCEDURE

A-4.1 Shake oil sample well and pour into six sample jars to the 37.5 mm mark and one sample jar to the 75 mm. Add reference oil to each of the sample jars to the 75mm-mark. Mix the oil thoroughly and heat to 46°C in a water-bath. After the oils reach room temperature, observe and record the colour and evidence of separation. Determine and record the pour point of each oil.

A-4.2 Maintain the temperature of the cooling bath at –1°C to +2°C. Support the jacket, containing the test jar, firmly in a vertical position in the cooling bath so that not more than 25 mm of the jacket projects out of the cooling medium.

A-4.3 Beginning at a temperature 12°C before the expected pour point, at each test thermometer reading, that is, a multiple of 3°C , remove the test jar from the jacket carefully and tilt it just enough to ascertain whether there is a movement of the oil in the test jar. The complete operation of removal and replacement shall require not more than 3 s. If the oil has not ceased to flow when its temperature has reached 10°C, place the test jar in the jacket in a second bath maintained at a temperature of –18°C to –15°C. If the oil has not ceased to flow when its temperature has reached –7°C , place the test jar in the jacket in a third bath maintained at a temperature of –34.5°C. For determination of very low pour points, additional baths should be maintained with successively lower temperature differentials of about 17°C. In each case transfer the test jar when the temperature of the oil reaches a point of 28°C, above the temperature of the new bath. At no time place the cold/test jar directly in the cooling medium. As soon as the oil in the test jar does not flow when the jar is tilted, hold the test jar in a horizontal position for exactly 5 s, as noted by a stop-watch or other accurate timing device, and observe carefully. If the oil shows any movement under these conditions, place the test jar immediately in the jacket and repeat a test for flow at the next temperature 3°C lower.

A-4.4 Continue the test in this manner until a point is reached at which the oil in the test jar shows no movement when the test jar is held in a horizontal position for exactly 5 s. Certain lubricating oils tend to move as a whole and should be very closely observed. Record the reading of the test thermometer at this temperature, corrected for error, if necessary. Allow the samples to thaw; and when the cloudiness has barely disappeared, observe and record the colour and evidence of separation. When the samples reach room temperature, place them in an oil-bath after removing the thermometers. Heat the bath at 230°C and immediately remove the sample jars. Cork the samples and store them at their respective pour points for 18 to 24 h. Remove the jars and allow the samples to thaw. When cloudiness has barely disappeared, observe and record the colour and evidence of separation. Repeat the last operation when the samples reach room temperature.

A-5 METHODS OF REPORTING RESULTS

A-5.1 Report evidence of separation in the following four successive stages:

a) Initial sample;
b) Warmed to just above cloud point after having once reached pour point;
c) After a cycle of heating to 230°C cooling to pour point, storing it for 24 h at this temperature and warming to just above pour point; and
d) Warmed to room temperature.

A-5.2 Evidence of separation is to be reported as:

a) Condition
    i) Definite
    ii) None or doubtful
b) Location
    i) Near top
    ii) Near bottom
    iii) Filament
    iv) Uniformly distributed
c) Particle size
    i) Small, as in cloud or haze
    ii) Specks or larger particles
d) Colour
    i) White or very light
    ii) Yellow
    iii) Black

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Lubricants and Related Products Sectional Committee, PCD 4

Organization	*Representative(s)*
Indian Oil Corporoation Ltd (R&D Centre), Faridabad	Dr A. K. Bhatnagar (***Chairman***) Shri N. R. Raje (*Alternate*)
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In order to provide for certification of lubricants for diesel and gasoline engines by an independent third-party like BIS, the procedure for qualification approval has been given in **5**. Bureau of Indian Standards may be contacted for further details of qualification approval and product conformity certification procedure. The procedure is in accordance with the ISO/IEC Guidelines 53. It is expected that having updated the standard in accordance with International practice, manufacturers of engine crankcase oils (gasoline and diesel) would opt for certification under BIS Certification Marks Scheme which would help combat the menace of spurious or non-conforming products. BIS Certification Marks Scheme is operated under a well-defined Scheme of Testing and Inspection (STI) designed and supervised by the Bureau but operated by manufacturers.

The Composition of the Committee responsible for formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

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